OPIC
Office de la propriété intellectuelle du Canada

CIPO
Canadian Intellectual Property Office

(12) (19) (CA) **Demande-Application**

(21) (A1) **2,341,398**

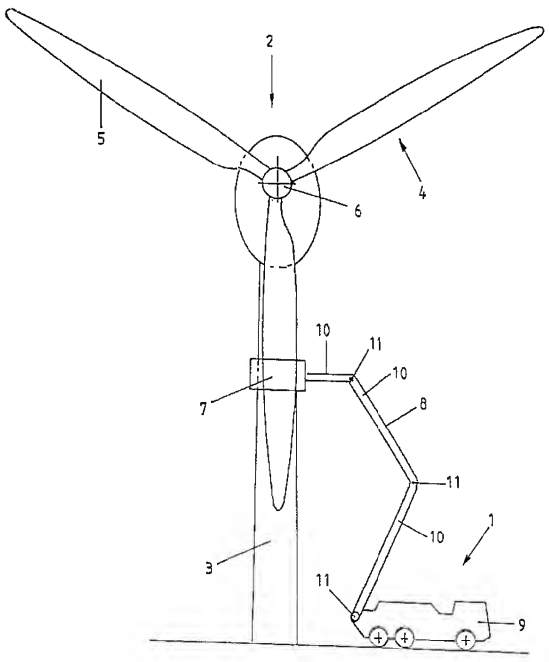
(86) 1999/09/08
(87) 2000/03/30

(72) SIEBERT, ANTONIUS, DE
(72) SANDER, HANS-JURGEN, DE
(72) ROBL, KLAUS, DE
(72) MERSCH, MARKUS, DE
(71) SIEBERT, ANTONIUS, DE
(71) ROBL, KLAUS, DE
(71) MERSCH, MARKUS, DE

(51) Int.Cl.[7] B66F 11/04
(30) 1998/09/22 (298 16 942.8) DE
(30) 1998/10/30 (298 19 391.4) DE
(30) 1999/03/05 (199 09 698.8) DE

(54) **DISPOSITIF POUR REALISER DES TRAVAUX DE REPARATION ET DE SERVICE SUR DESPALES DE ROTORS DE CENTRALES EOLIENNES**

(54) **DEVICE FOR CARRYING OUT REPAIR AND SERVICE WORK ON ROTOR BLADES OF WIND TURBINE GENERATORS**



(57) A device for carrying out repair and service work on objects that are exposed to the effects of the weather. The inventive device is made of plastic, aluminium or the like, and is especially designed for carrying out maintenance and renovation work on rotary blades of wind turbine generators. The aim of the invention is to enable maintenance and repair work to be carried out on said objects during all types of weather conditions. This is achieved by means of a working cabin (7) that accommodates areas of the rotor blades (5). Said working cabin includes sealing devices (17-19) that seal off the cabin from the effects of the environment in the work location.

Abstract:

By means of a device for carrying out repair and service work on objects of fibre-reinforced plastics, aluminium or the like, exposed to the effects of the weather, in particular for the maintenance and service of rotor blades of wind turbine generators, an object of permitting maintenance and repair work on such objects during virtually any type of weather conditions is to be attained.

This is attained by a working cabin (7) accommodating portions of the rotor blade (5) and comprising sealing means (17-19) for sealing off the working cabin (7) from the effects of the environment prevailing at the work location.

Please refer to the figure for publication: Fig. 1

Device for Carrying Out Repair and Service Work on Rotor Blades of Wind Turbine Generators

The invention relates to a device for carrying out repair and service work on rotor blades, exposed to the effects of the weather, of wind turbine generators of the type described in the generic clause of claim 1, as described, for example, in DE-U 296 03 278.

For repairs on surfaces of non-metallic materials special conditions must usually be adhered to. The "Germanic Lloyd", for example, issues guidelines relating to such repair work of structural components.

In order to be able to meet all these special characteristics, it is known, for example, when repairing rotor blades of wind turbine generators, to dismantle the rotor blades and to transport them to a workshop hall in order to bring about there the external conditions in such a manner as to comply with the standards and recommendations of the "Germanic Lloyd". The effort involved is considerable, the stand down periods of the wind turbine generators are correspondingly high so that one seeks, if at all possible, to perform these repair and maintenance services on site directly on the rotor.

Repair platforms are therefore known, which may be lifted and lowered on the mast of a wind turbine generator, for example, by winches, openly surrounding a rotor blade in the process. Such an arrangement is described in DE-43 39 638-A1 or DE-197 26 408-C1. A similar installation is shown in the genus constituting DE-296 03 278-U1, which is characterised in that the suspension device is fitted to the root of the two rotor blades pointing upwardly while the third rotor blade is being serviced, which presupposes that a wind turbine generator is designed to comprise three blades.

The drawback shared by these working platforms resides in particular in the fact that they can only be used in good weather conditions, as otherwise the parameters prescribed by the "Germanic Lloyd" cannot be adhered to.

This is where the object of the invention comes into play, which consists in providing a device, which permits maintenance and repair work on such objects during virtually all types of weather conditions.

This object is attained according to the invention by a device of the type described in the opening paragraph in that the working platform forms part of a working cabin, substantially U-shaped when viewed in plan view, for accommodating the rotor blade on the side comprising a walking and working deck, U-shaped when viewed in plan view, as well as sealing means for sealing the working cabin from the effects of the environment prevailing in the work location as well as for sealing, in particular, the ceiling and floor in relation to the portion of the rotor blade inside the working cabin.

In such a working cabin encompassing a portion of the rotor blade, all required parameters, necessary for performing the tasks, can be set. In this manner the temperature, the air humidity and the like, to name but one example, may be set. It may be mentioned here that extraction hoods, e.g. for façade cleaning, are available, see EP-A-0 396 815.

Embodiments of the invention are apparent from the subsidiary claims.

The device may, of course, also be equipped with a lifting device, for example with winches as disclosed in prior art, or with gantry arms of a lifting platform or the like. Since the rotor blade passes through the cabin, the latter comprises sealing components in the floor and ceiling as well, the said sealing components ideally being formed by a plurality of plungers, which can travel from a starting position to a sealing position. It may be advantageous in the process to fit the joint plunger ends with an inflatable tube body in order to permit particularly good sealing off from the environment. Actuating these sealing plungers may be performed pneumatically, hydraulically, magnetically or electrically.

which, when a rotor blade is dismantled and removed from the mast of the wind turbine generator, displaces the rotor blade in the working cabin in such a manner that an approximately central point of gravity of the system as a whole is attained. The lifting element of the working cabin subsequently lowers these in the direction towards the ground and deposits the working cabin in such a manner as to be employed as a slip carriage.

An alternative embodiment may be that the lifting device is formed by a rail comprising a cable pull arrangement for transporting the working cabin, fitted to and/or adapted to be fitted to the mast of the wind turbine generators, in which case the rail may, for example, be designed as a telescopic component of a mounted vehicle structure.

Such a construction allows to use the carrying capacity of the mast as well in order to move the working cabin according to the invention. Depending on the location and the construction, the rail may also be an integral component of the mast.

The rail arrangement may be equipped with fixation means for fixation on the mast of the wind turbine generators, as is also contemplated by the invention in a further embodiment.

Further features, details and advantages of the invention are set out on the basis of the following description as well as with reference to the drawing. There is shown in a very simplified illustration in

Fig. 1 a device according to the invention in working position in a side elevation,

Fig. 2 a working cabin viewed in plan view in its open state,

Fig. 3 a working cabin viewed in plan view in its closed state,

Fig. 4 a working cabin in section IV-IV according to Fig. 2,

Fig. 5 a working cabin section V-V according to Fig. 3 as well as in

Fig. 6 the side elevation of a wind turbine generator with a rail arrangement against the mast.

Fig. 1 shows a device 1 for the maintenance of wind turbine generators in working position of a wind turbine generator 2. The wind turbine generator 2 comprises a support mast 3 in the upper region of which a rotor 4 is provided. The latter comprises three rotor blades 5, fitted to a hub 6. The hub 6 serves simultaneously as the rotational axis of the rotor 4 and is connected in known manner, for example, by way of a transmission gear, not shown in the present case, to a generator, likewise not shown. The power take-off of the hub 6 is so designed in known manner that the latter may be locked in a plurality of positions, so that, for example, dismantling of the rotor blades 5 may be performed.

The device for servicing wind turbine generators 1 comprises a working cabin 7, connected to a vehicle 9 by a lifting arm 8. The vehicle 9 may be an independent truck or may, for example, take the form of a trailer with auxiliary aggregates. The lifting arm 8 comprises a plurality of arm segments 10, interlinked by joints 11. In the embodiment here illustrated three arm segments 10 are used, however, the number of arm segments 10 is, in principle, variable at will. The arm segments themselves may be designed as telescopic arms so that the maximum attainable working height of the working cabin 7 may be increased. The joints 11 may, for example, be moved by hydraulic cylinders.

Fig. 2 shows the working cabin 7 in a first configuration when viewed from the top. It comprises a transverse wall 12, rigidly fitted to an arm segment 10. On the side of the transverse wall 12 facing away from the arm segment 10 a longitudinal wall 13 each is provided on both sides. On its top surface and its bottom surface, see Fig. 4, the working cabin is closed in each case by a ground plate 14 cut out in U-shape as well as by a ceiling plate 15. As a result the working cabin 7 possesses a channel-like rebate 16 into which a rotor blade 5 may be inserted. In the case of a fixed rotor 4 the rotor blade 5 may be brought into the operating position according to Fig. 2 by moving the working cabin 7 by means of the lifting arm 8.

Both in the region of the bottom panel 14 and in the region of the ceiling panel 15 the working cabin 7 comprises a tube body 17, fitted on both sides of the U-shaped rebate. This tube body may be inflated and pressed against the surface of the rotor blade 5 by plungers 18, see Fig. 3. The plungers 18 may, for example, be moved hydraulically or by compressed air. For this purpose the plungers 18 are movably arranged in the bottom panel 14, the ceiling panel 15 respectively. Instead of

individual plungers. 18 larger panel segments may also be used in the present example.

Fig. 3, shows the seals in the closed position with the tube body 17 placed against the rotor blade 5. A sliding door 19 disposed on the side of the working cabin 7 facing away from the arm segment 10 seals off the working cabin 7 from the outside. In this configuration the working cabin 7 is sealed off to a large extent from the outside so that work on the enclosed portion of the rotor blade 5 may be performed without being exposed to the effects of the weather conditions outside.

Fig. 4 shows the first configuration of the working cabin 7 according to Fig. 2 in the section according to IV-IV. Fig. 5 shows correspondingly the working cabin 7 in the second configuration according to Fig. 3 in the section V-V. Both figures exemplify that the rotor blade 5 may be fixed in the rebate 16 of the working cabin 7 even in a position, which deviates distinctly from the vertical.

In the following a process for servicing wind turbine generators by means of the afore described device is illustrated. In the first configuration according to Fig. 2 or Fig. 4 the working cabin 7 is brought by means of the lifting arm 8 into such a position that the rotor blade locked in a position pointing approximately vertically downwardly comes to rest in the rebate 16. The tube body 17 is then pressed against the surface of the rotor blade 5 by means of the plungers 18 so that the interior of the working cabin 7 is sealed off to a large extent from the environment. Maintenance work on the rotor blade 5 may now be performed inside the working cabin 7 regardless of the weather conditions.

The working cabin 7 may furthermore be fitted with extractor means so that, for example, sand blasting or grinding work is possible without negatively influencing the environment. As soon as a segment of a rotor blade 5 is treated, the tube body 17 is released from the surface of the rotor blade 5 so that the working cabin 7 is once again returning to a configuration according to Fig. 2 or Fig. 4. In this configuration the working cabin 7 is adapted to move along the rotor blade 5 and may be brought into a new position.

By pressing the tube body 17 against the surface of the rotor blade 5 a closed working space may again be brought about at the desired, new position. In this manner the entire rotor blade 5 may gradually be covered with the working cabin 7.

By rotating the rotor 4 and by renewed blocking, the other rotor blades 5 may also be treated correspondingly.

Not illustrated in detail is the possibility to equip the working cabin 7 with a gripping means, permitting to fasten a dismantled rotor blade 5 in order to deposit it on the ground by way of the lifting device 8. The working cabin 7 may in this context also take the form of a so-called slip carriage, for example with running wheels fitted to the rear wall, so that the dismantled rotor blade may be transported by the working cabin to a workshop hall or the like.

Fig. 6 shows an alternative embodiment of the device according to the invention, all elements which are identical with regard to their function having the same reference numerals as in the preceding description.

In the present case likewise denoted in general as 1, the device serves for the maintenance and cleaning of rotor blades 5 of the rotor 4 of a wind turbine generator, generally denoted as 2, at the upper end of a support mast 3. According to this variation a rail system 20, on which a carriage 21, including the working cabin 7, is movably provided, may be placed against or fitted to the support mast 3 from a vehicle 9,.

A cable pull arrangement 22 is illustrated in dotted lines merely symbolically, on which the cabin 7 may be raised and lowered, the associated winch may, for example, be positioned on the vehicle 9.

By way of an additional knee arm 23 Fig. 6 indicates that the rail system 20 may also be designed as an integral structural part of the vehicle 9, for example, in the manner of a telescopic ladder or the like, a segmental assembly in the manner of a plugging-together system may, of course, also be provided. The figure further shows clamp-like components 24 by means of which the rail system may be fixed to the mast.

It goes without saying that the described embodiments of the invention may vary in many further respects without departing from the basic concept. The working platform 7 may thus, for example, be adjustably arranged on the carriage 21 in the horizontal plane, in order to be able to compensate, where necessary, for varying rotor blade spacings, to mention just one example.

Patent Claims:

1. Device for carrying out repair and service work on rotor blades (5), exposed to the effects of the weather, made of fibre-reinforced plastics, aluminium or the like, of wind turbine generators comprising a working platform, adapted to be raised and lowered, in order to accommodate portions of the rotor blade (5)
characterised in that
the working platform forms part of a working cabin (7), substantially U-shaped in plan view, for sideways accommodating the rotor blade (5) comprising a walking and working deck, U-shaped in plan view, as well as sealing means (17-19) for sealing the working cabin (7) from the effects of the environment prevailing on site as well as for sealing, in particular, the ceiling and floor regions in relation to the region of the rotor blade (5) inside the working cabin.

2. Device according to claim 1,
characterised by
a lifting device (8) for guiding the working cabin (7) over the length of a motor blade (5).

3. Device according to claim 1 or 2,
characterised in that
the floor and ceiling regions (14, 15) of the working cabin (7) are provided with a plurality of plungers (18), adapted to move between a starting position and a sealing position.

4. Device according to any one of the preceding claims,
characterised in that
the free front ends of all adjoining plungers (18) are equipped with a jointly inflatable tube body (17).

5. Device according to any one of the preceding claims,
characterised in that
the actuation of the sealing plungers (18) is performed pneumatically, hydraulically, magnetically or electrically.

6. Device according to any one of the preceding claims,
characterised in that
the working cabin (7) is equipped with an air conditioning installation, in particular for heating, ventilating and air extraction.

7. Device according to any one of the preceding claims,
characterised in that
the working cabin (7) including a lifting device is associated with a gripping device for gripping a rotor blade.

8. Device according to any one of the preceding claims,
characterised in that
the working cabin (7) including a lifting device (8) is designed as a mounted structure of a vehicle (9).

9. Device according to any one of the preceding claims,
characterised in that
the working cabin (7) takes the form of a slip carriage for the fixation, conveyance and longitudinal turning of a rotor blade (5).

10. Device according to any one of the preceding claims,
characterised in that
the lifting device (8') is designed as a rail system (20) fitted and/or adapted to be fitted to the mast (3) of the wind turbine generators, including a cable pull arrangement (21) for conveying the working cabin (7).

11. Device according to claim 10,
characterised in that
the rail system (20) takes the form of a telescopic component of a vehicle structure.

12. Device according to claim 10 or 11,
characterised in that
the rail system (20) is equipped with fixation means (24) for fixation on the mast of the wind turbine generator.

Fig.1

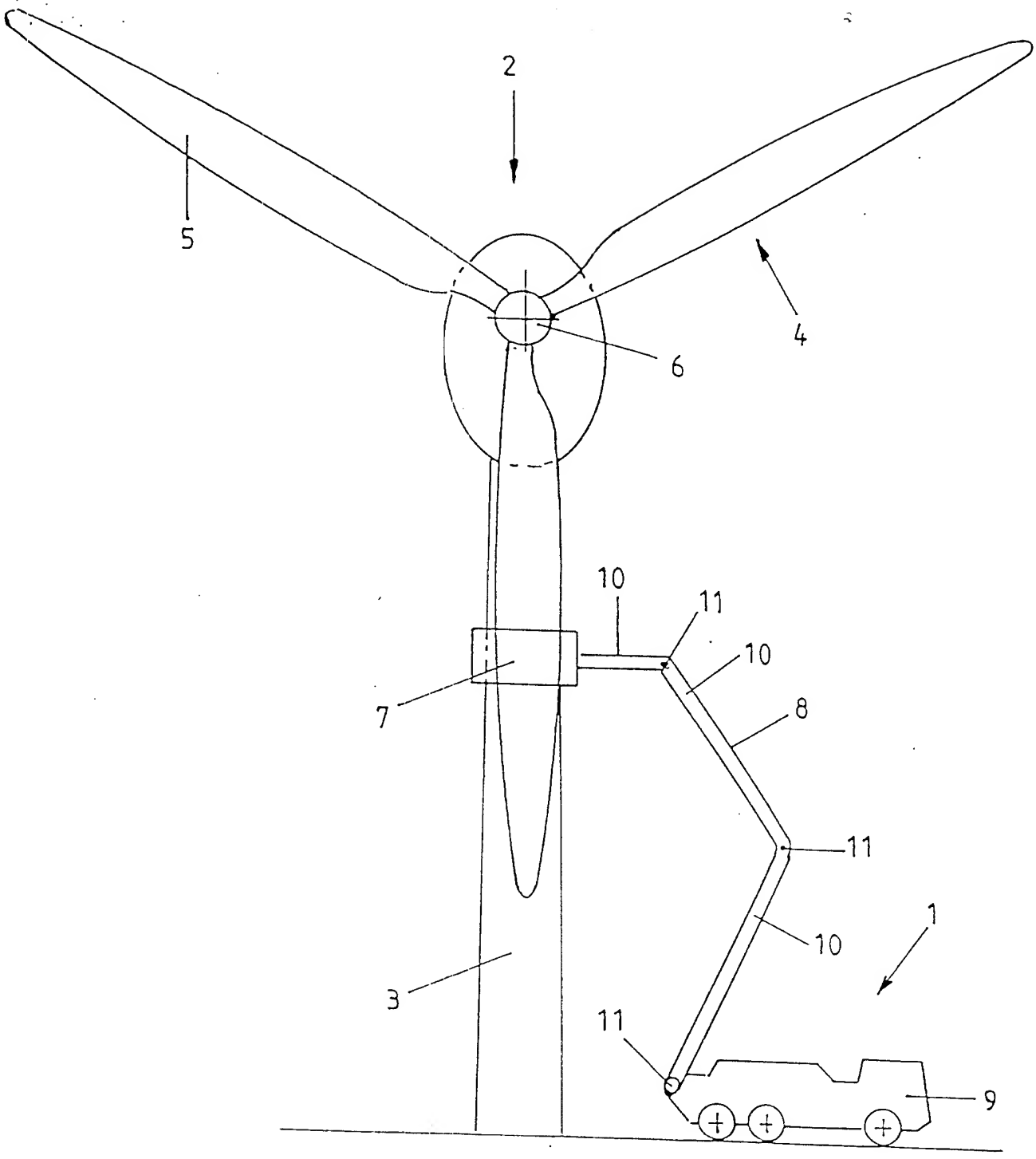


Fig. 2

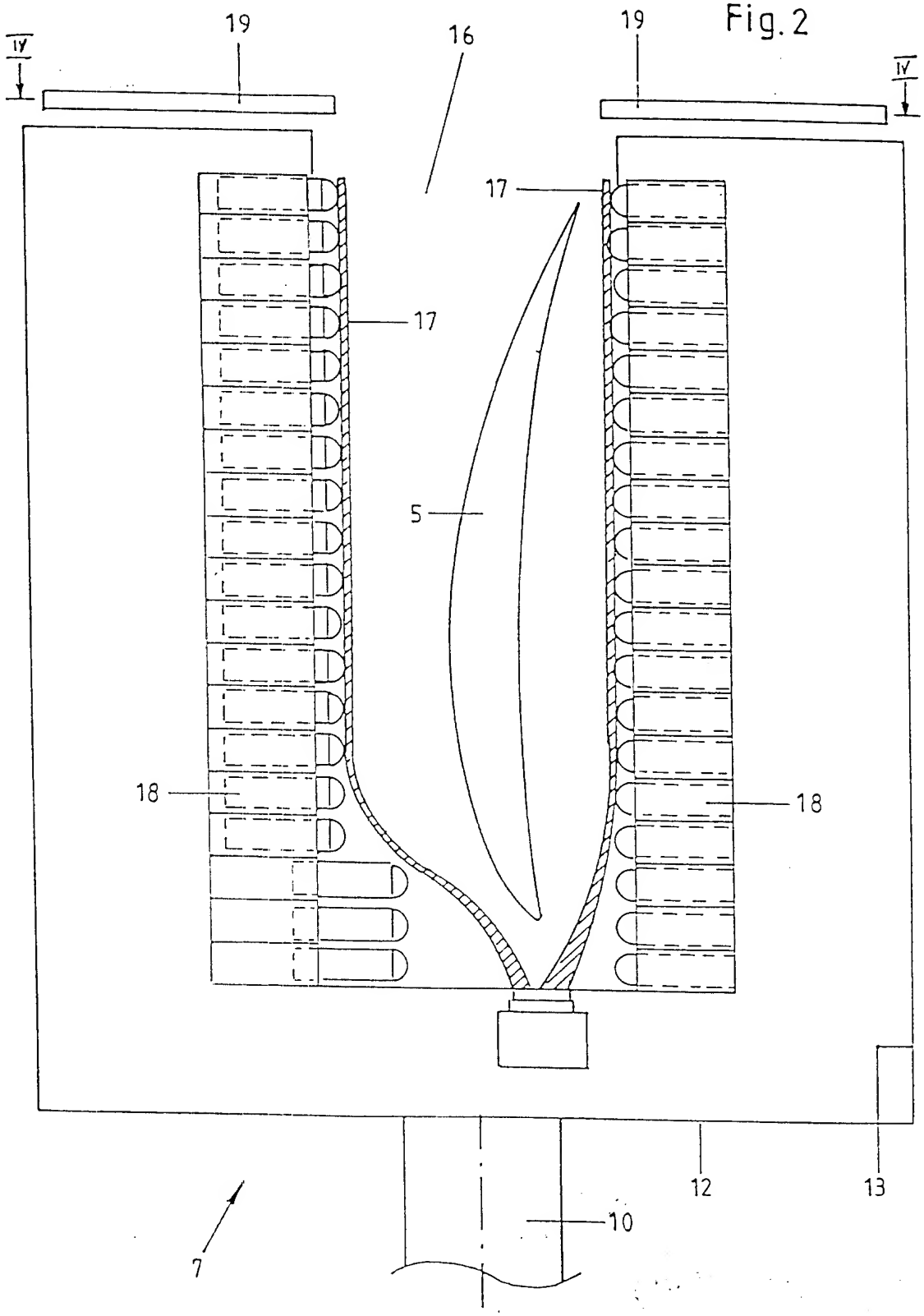


Fig.3

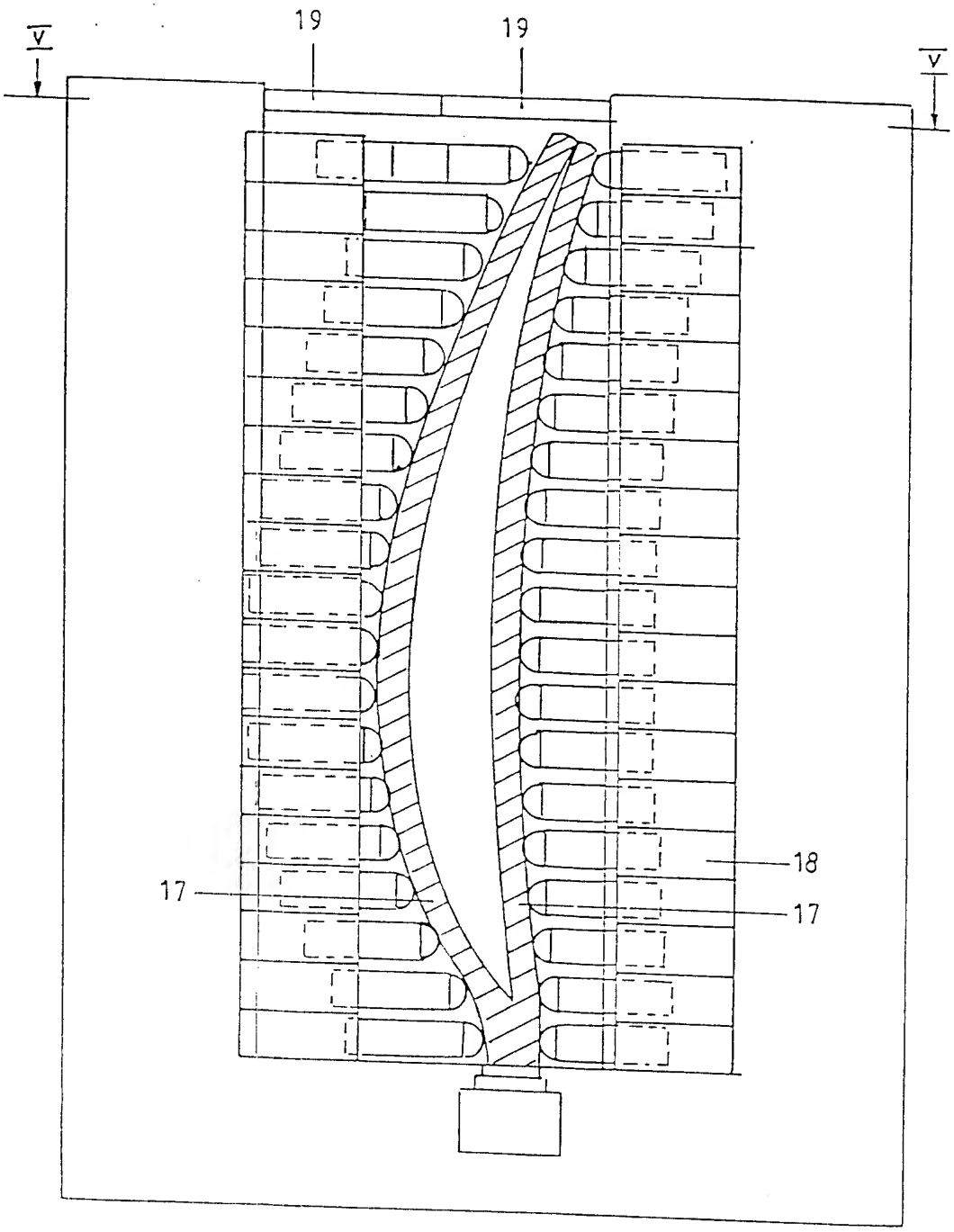


Fig.4

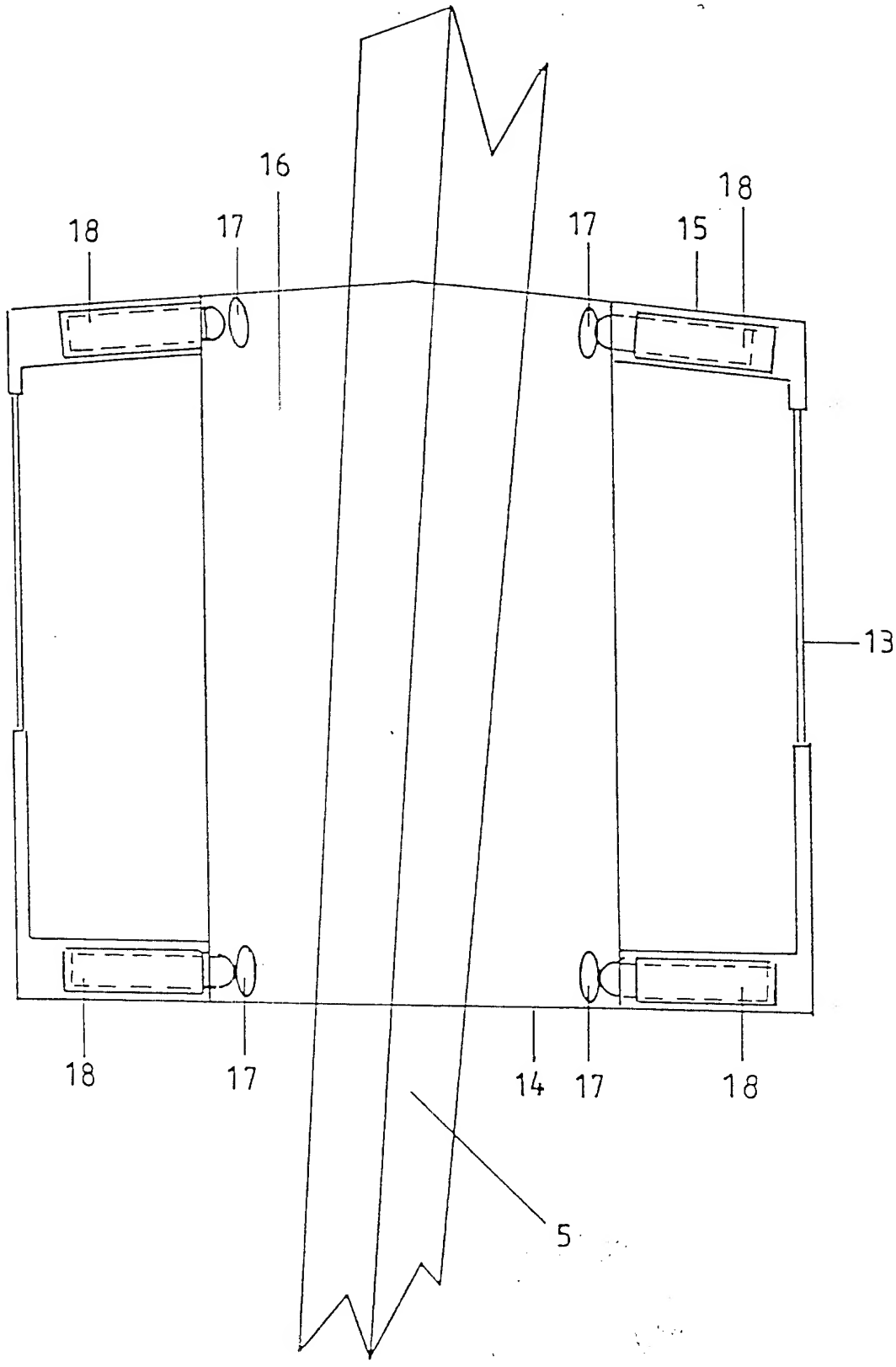
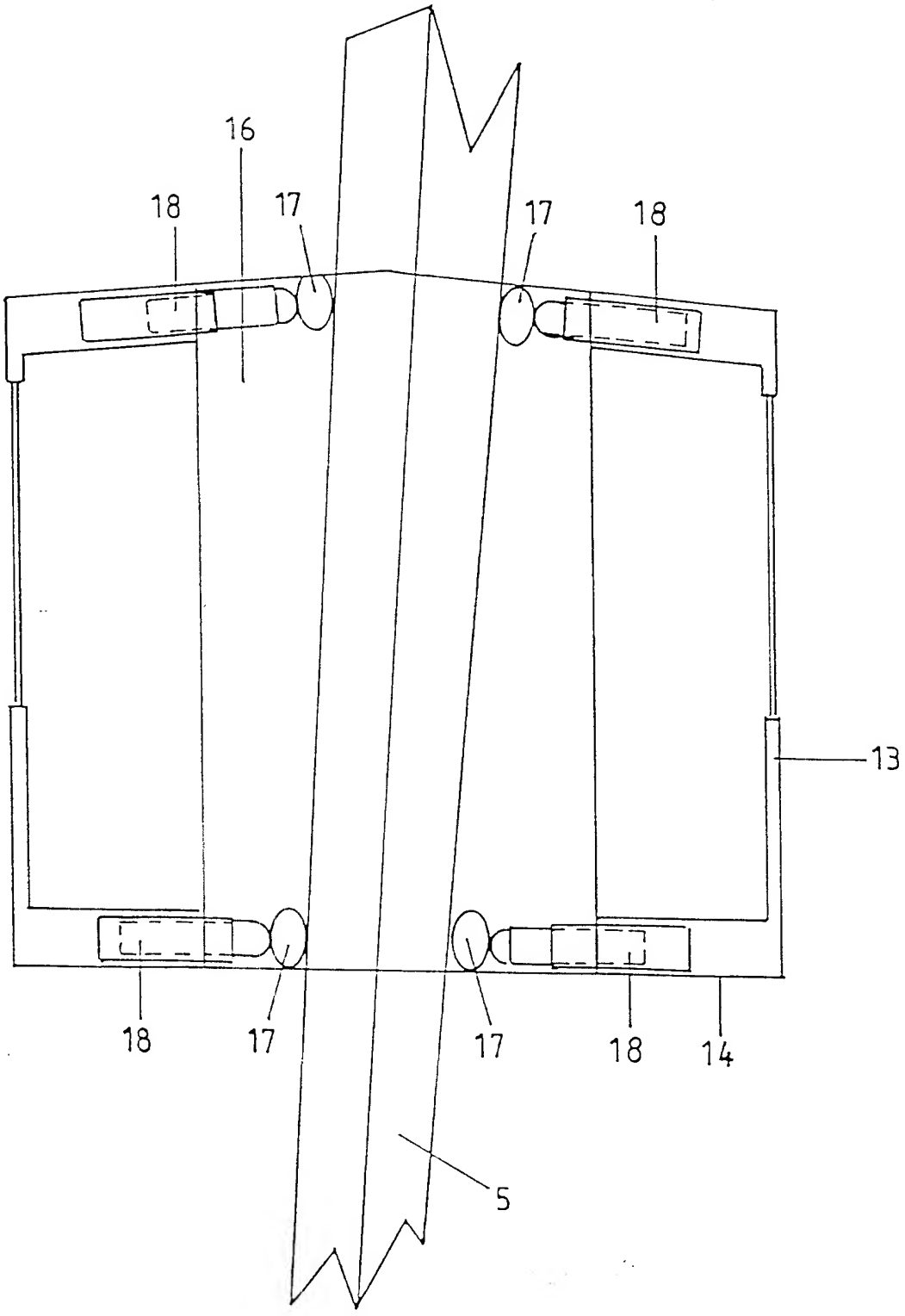
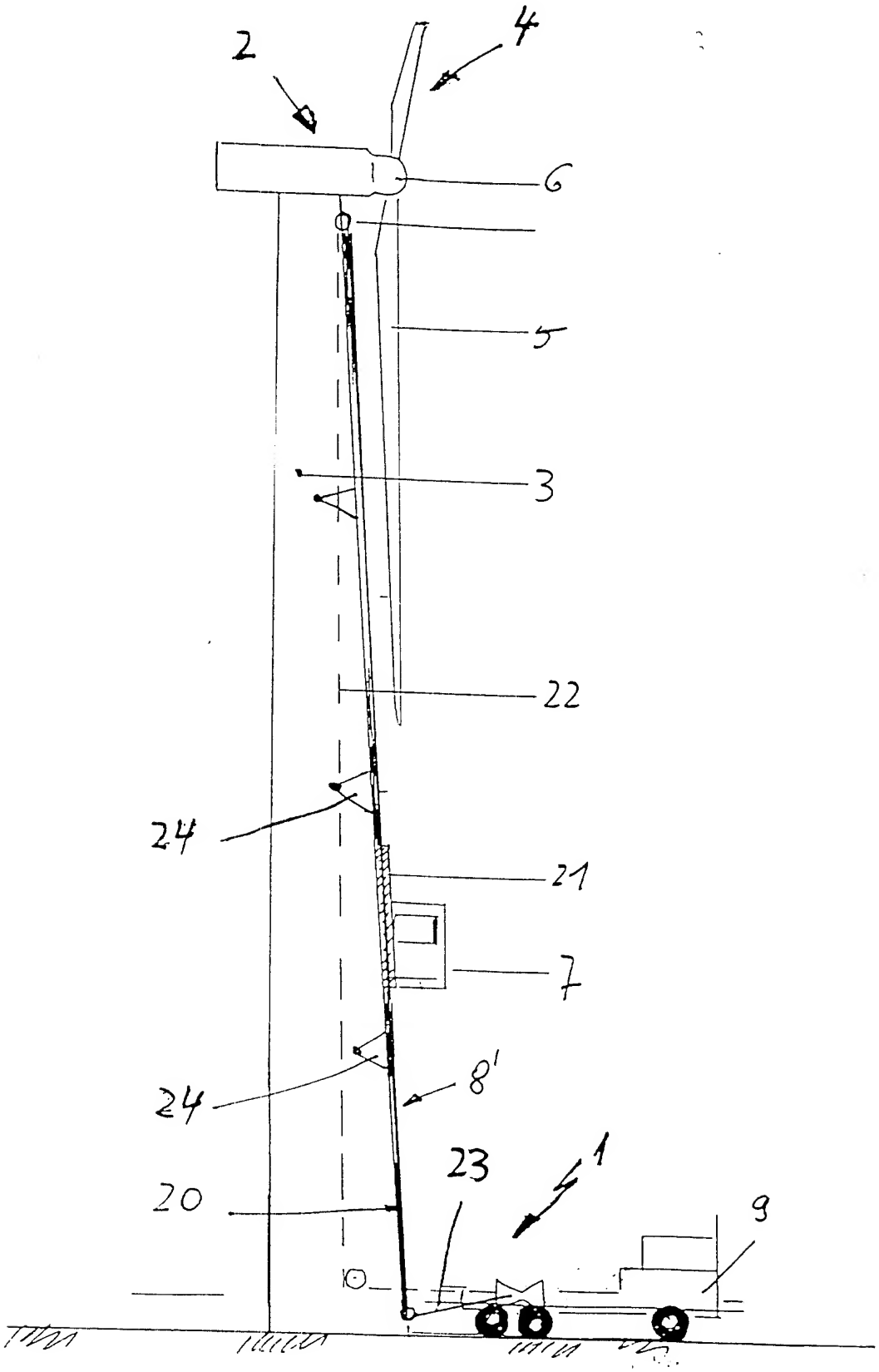


Fig. 5





CA 02341398 2001-02-21

Fig. 6